Rush Skeletonweed Task Force
YEAR 2003
End of Year Report

<u>Photo: G. P. Markin-USFS</u>

Table of Contents

Topic	Page
Introduction	**2**
Summary of Year 2003	**2-6**
Contributions and Expenditures	**7**
Steering Committee	**Appendix I**
Project Summaries	**Appendix II**
Maps	**Appendix III**
Reports	**Appendix IV**

Introduction

<u>Mission Statement</u>

To reduce and stop the spread of Rush Skeletonweed, and reduce its impact by maximizing the effectiveness of integrated control methods across all land ownerships.

The Rush Skeletonweed Task Force was developed in part to find and establish effective biocontrols for rush skeletonweed and coordinate control efforts over the long-term. The Task Force has developed common objectives, and set realistic research priorities.

The goals of the Rush Skeletonweed Task Force are to: Develop the most economical and effective control method (biocontrol) for Rush Skeletonweed; Prevent the spread of Rush Skeletonweed; Reduce the extent and density of established Rush Skeletonweed to levels that are acceptable; Educate the public as to the importance of proper weed management and get the needed media coverage to show what is being done.

The area covered by this effort includes the entire State of Idaho, and will also benefit Montana, Oregon, and Washington at least.

Summary of Year 2003 Projects

This year was another big success for the Rush Skeletonweed Task Force. The program is definitely growing each year and our reputation is spreading. The following were the primary accomplishments this year:

- Additional collections of *Bradyrrhoa gilveolella* in Greece
- *B. gilveolella* reared in Bozeman for release
- *F*ive *B. gilveolella* field releases
- Determination that *B. gilveolella* is able to overwinter in Idaho
- *B. gilveolella* established both a laboratory colony and insectary (Nez Perce Biocontrol Center)
- Began development of artificial diet for accelerated rearing
- Identified new populations in Greece and Bulgaria, for collections of *B. gilveolella*
- Sampled sites in Greece and Bulgaria to determine habitat characteristics that are conducive for the moth
- Identified as many as 10 potential additional agents apparently impacting native populations of rush skeletonweed

Priority 1 Project - Release and Rearing of Bradyrrhoa gilveolella

First Release of the root moth Bradyrrhoa gilveolella in North America November 26, 2002
South Fork Payette River

Bradyrrhoa gilveolella (Treitschke) (Lepidoptera: Pyralidae) is a root-feeding moth being considered for use in the biological control of rush skeletonweed, *Chondrilla juncea* L. (Asteraceae). This organism will serve to complement the existing biocontrol agents that have been established on rush skeletonweed in the Pacific Northwest but have provided only limited suppression of the weed. In autumn 2002 the USDA-APHIS approved this moth for field release. In November 2002 the first release of the moth (as infested plants) was made near Garden Valley, Idaho. Key to the success of this agent is our ability to effectively establish and redistribute the moth. For the 2003 field season we continued with the release of the moth and initiated a study to determine habitat associations of the moth in Europe so that we may seek similar sites in North America for future releases.

Two collections of rush skeletonweed roots infested with *Bradyrrhoa* larvae were made near Lake Prespa in northwestern Greece. Roots were sent or hand carried to the Insect Quarantine Laboratory located at Montana State University. Approximately 57 adult moths were reared from the first collection from northern Greece. From these adults we obtained a little less than 3,400 eggs. Egg viability was estimated at 82%. The resulting larvae were used for field release, establishing a laboratory colony and for diet and feeding studies. Viable eggs were also sent to the Nez Perce Biocontrol Center to start a field insectary. The second shipment of roots was received in September 2003 and the larvae from this shipment were transferred to plants for additional rearing in the quarantine lab.

Releases were made in August 2003 at four sites in southern Idaho: Goodrich, Banks, Garden Valley, and Idaho City. Approximately 1,020 larvae were placed on plants at these field locations. Sites were revisited on 20 September 2003 and ten plants were inspected for the establishment of larvae. Larvae were located at two sites. Hot temperatures during the release of the larvae may have contributed to the poor establishment at the other two sites. These sites will be revisited in 2004. An additional release of *Bradyrrhoa*, using eggs obtained from laboratory rearing, was made in October 2003 near the Salmon River.

A few infested plants were placed near Garden Valley, ID in November 2002. Plants were removed in September 2003 and dissected. Although few in number, nearly all the larvae pupated and emerged as adults. This indicates the likelihood that *Bradyrrhoa* will be able to survive the Idaho winters.

A laboratory colony is being maintained at MSU and at the USFS Forestry Science Laboratory, Bozeman. We hope to continue the colony so that additional moths may be released in 2004. To augment the rearing of the moth, work on the development an artificial diet began. On preliminary diets, larvae fed for extended periods and more mature larvae completed their development to emerged as adults. Studies were also initiated to investigate the impacts of larval feeding on the root.

Infested Rush Skeletonweed plant in a pot

Placing the pot with the root moth in the ground

Priority 2 Project - Determine habitat associations of *Bradyrrhoa gilveolella* in Europe.

A total of nine sites were surveyed in Greece, six in Bulgaria, and eight in Idaho. Aspect, slope, elevation, average *C. juncea* plants per area, presence of *B. gilveolella*, and other site parameters were recorded for each site visited. A total of three surveyed sites in Europe contained *B. gilveolella.* Soil samples were also taken at each site. Data analysis for the European and Idaho sites will be conducted this winter.

Priority 3 Project - Foreign Studies on Biological Control of Rush Skeletonweed

While very promising, it is unlikely that Bradyrrhoa gilveolella will give complete control of the skeletonweed. Therefore, the Task Force is continuing its search for additional agents, which will compliment the impact of *Bradyrrhoa*.

From 2001 to 2003, cooperators with the Rush Skeletonweed Task Force inventoried the other natural enemies of rush skeletonweed around the Black Sea, an area climatically similar to the Northern Rockies. To date, over 50 insects have been found attacking rush skeletonweed in this area, of which 10 appear to have potential as biological control agents.

Photo: G. P. Markin-USFS

Small larvae of the moth *Schinia cognate* mining inside a bud of rush skeletonweed.

Photo: G. P. Markin-USFS

Larvae of an unknown Cerimbicea beetle, commonly found mining in the stem of dying *Chondrilla juncea* plants along the coast of northern Greece.

Additional inventory was conducted in Greece, Bulgaria, and Russia. The work in Russia appears very positive due to the similarity of their climate and habitat to that of the US.

Photo: Mark Volkovitch

Figure 14. Larvae of *Cucullia balsamitae* Boisd. (Lepidoptera: Noctuidae) feeding on *Chondrilla juncea*, Astrakhan province, southern Russia.

Photo: Mark Volkovitch

Figure 15. Larva of wooly bear (Lepidoptera: Arctiidae) feeding on *Chondrilla juncea*, Astrakhan province, southern Russia.

Priority 4 Project - Education

2003 Rush Skeletonweed Task Force (RSWTF) Project

$6000 was allocated from the RSWTF for educational outreach and community involvement with matters pertaining to rush skeletonweed, a noxious weed prevalent in Southwestern Idaho. Bureau of Land Management, Idaho Department of Lands, Ada County, and University of Idaho personnel identified a site on state land that will allow long term monitoring in a rush skeletonweed infested 2001 fire. Micron Technology has granted us access across their private land to conduct this study.

Six volunteers with a desire to help the cause of noxious weed abatement and control have helped with this project to date. With their help and the help of other cooperators, a significant amount of hands-on work has been done on this site in the name of rehabilitation. The goals of education and community involvement have been initiated.

The Project:

In cooperation with Dr. Tim Prather from the University of Idaho, methods were developed that will promote competition between invasive species, specifically rush skeletonweed, and grasses, forbs, and shrubs.

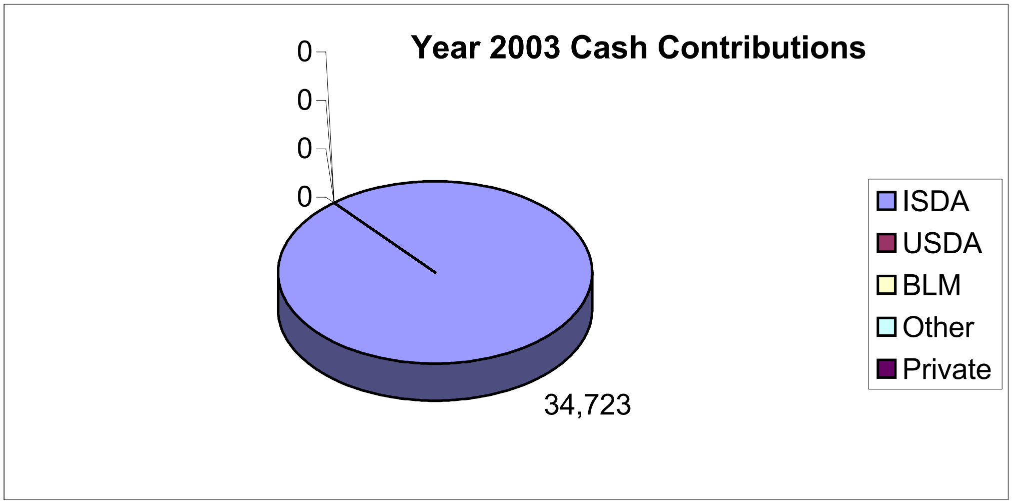
1) A total of five acres were flagged for monitoring on State of Idaho land
2) The five acres consist of four one acre plots that were sprayed and seeded, one ½ acre plot was sprayed, and one ½ acre plot was left unsprayed as a control.
3) The plots were drill seeded by the BLM with seed mixtures noted below
4) A temporary four wire fence exclosure was erected to keep cows off of the study site
5) A yearly progress report will be submitted to the Idaho Department of Lands documenting observations
6) This site will be monitored for approximately five years with the help of students and volunteers

A total area of 160m x 160m were fenced off with four replications. The plot design is as indicated on the following page.

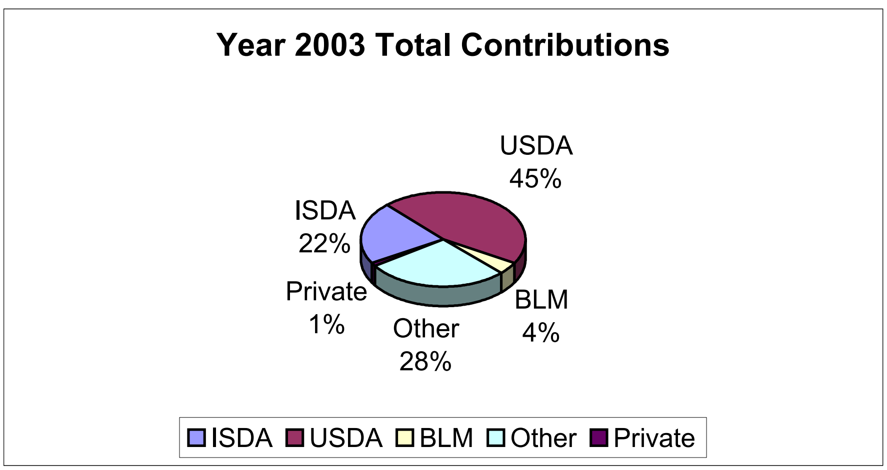
In two plots the grass component consists of Snake River Wheat Grass (*Agropyron spicatum*), Sandburg's Bluegrass (*Poa sandbergii*), Basin Wild Rye (*Elymus cinereus*), and Bottlebrush squirreltail (*Sitanion hystrix*). The other two plots were seeded with Siberian Wheat Grass (*Agropyron sibericum*) to assess introduced grass species' ability to compete with the annuals at the site. Forbs included Yarrow (*Achillea millefolium*) and Balsamroot (*Balsamorhiza sagittata*) in all plots. The shrub component included Wyoming Big Sage (*Artemisia tridentata ssp. wyomingensis*) from seedlings, also in all four plots.

Contributions and Expenditures for the 2003

The following pie chart shows a break down of all cash contributions obtained for the Rush Skeletonweed Task Force in the 2003 season. A total of $36,489.24 was received.



The following pie chart shows a break down of cash funds, contributed time, equipment, and supplies for the Rush Skeletonweed Task Force. $126,626 was contributed (matching dollars), by cooperators and individuals**. This totaled $163,115.24 for the 2003 season.**



2004 (Next Year) Season

The Rush Skeletonweed Task Force has big plans for 2004 . Two main projects will be continued, that of rearing and releasing more Bradyrrhoa, and expanding studies abroad to find additional biocontrol agents.

Appendix I (required)

Steering Committee

Chairman	Vice Chair	Secretary
Name Steve Spafford	Name Unclear at this time	Name Arin Nesbitt
USFS	XXXX County	SW Idaho NRCS
Meridian, ID 83642	City, ID	Meridian, ID 83642
Phone 208-365-7012	Phone	Phone 888-1890, ext.4
Email Address sspafford@fs.fed.us	Email Address	Email Address

Rush Skeleton Weed Task Force 2003

George Markin
Forest Service Lab MSU
Bozeman, MT 59717

Jim Cornwell
9173 W. Barnes Dr.
Boise, ID 83709

Jerry Scholten
15168 A.E. Hwy 21
Boise, ID 83716

Warren Ririe
1249 S. Vinnell Way, St. 200
Boise, ID 83709

Pat Kane
BLM
3948 Development Ave.
Boise, ID 837058

Brenda Waters
ISDA
P.O. Box 7249
Boise, ID 83707

Tim Prather
University of Idaho
Moscow, ID 83707

Mark Schwarlaender
University of Idaho
Moscow, ID 83844

Mike Bottoms
Boise County Weed Control
P.O. Box 1300
Idaho City, ID 83631

Russ Cleary
ISDA
P.O. Box 7249
Boise, ID 83701

Danielle Bruno
ISDA
P.O. Box 7249
Boise, ID 83701

Brian Wilber
Ada County Weed Control
571 N. Meridian
Meridian, ID 83642

Appendix II (required)

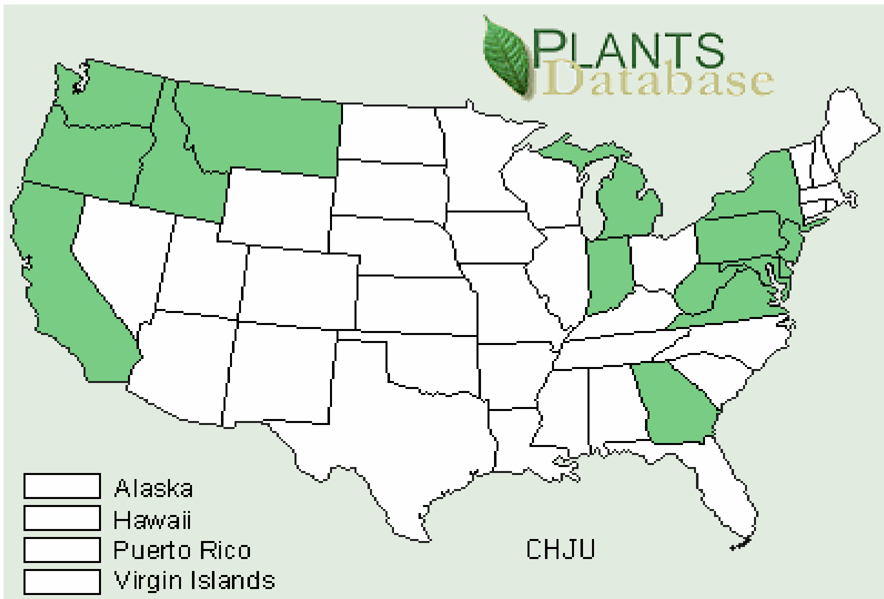
Project Summaries:

Category	Weed species	Acres treated
Rearing and Release of Bradyrrhoa	Rush Skeletonweed	5 releases - 1000
Study habitat associations of *Bradyrrhoa gilveolella* in Europe		15 locations in Europe were compared with 8 in North America
Studies for new agents	Rush Skeletonweed in Russia	Ongoing Studies
	Rush Skeletonweed in Greece	Ongoing Studies
	Rush Skeletonweed in Bulgaria	Ongoing Studies
Educational outreach and community involvement	Began a test plot to determine methods to rehabilitate areas infested with Rush Skeletonweed	Installed test plot

Appendix III (Important, but not required)

Maps

Distribution of Rush Skeletonweed



Appendix IV (Optional)

Reports

1. **2003 Annual Report of Research on Rush Skeletonweed**
2. **2003 Rush Skeletonweed Biological Control - Project Summary for *Bradyrrhoa gilveolella***

1. 2003 Annual Report of Research on Rush Skeletonweed
Chondrilla juncea (L.): ASTERACEAE

Prepared by George P. Markin, USFS, and Jeff Littlefield, Dept. of Entomology, MSU

Photo: G. P. Markin-USFS

Figure 1. Rush skeletonweed (*Chondrilla juncea*) in southwestern Idaho.

Problem

Rush skeletonweed is a deep tap-rooted, perennial plant native to Eurasia introduced to the United States sometime before 1933 (Sheley and Hudak 1995; Sheley and Stivers 1999; Whitson 1991). It was originally considered to be primarily a weed of open, drier grasslands of western Oregon, Washington, and northern California, but has rapidly expanded its range and is now also a problem in the Okanogan Valley of British Columbia. The most recent new infestation, however, is in southwestern Idaho, where it is rapidly invading the sagebrush covered foothills and northern edge of the Snake River plains. Also, in the drier granitic mountains north of that area it has become a very severe problem on National Forest lands, particularly after wildfires, which create an ideal habitat for its establishment and further spread.

Rush skeletonweed is also a pest in several other countries around the world, particularly Australia, where in the 60's and 70's it was considered one of the most destructive weeds in the dry land wheat-producing areas (McVean 1966). In an effort to control it, the Australians initiated a program of biological control, which by the 1980's had successfully introduced three biocontrol agents, which gave them almost complete control of this weed. Unfortunately, while the same three agents were introduced into North America and became established, they have proved ineffective. In the mid-1990's, a renewed effort was undertaken to find and introduce a new complex of biocontrol agents to North America. This is a cooperative project between the USDA Forest Service, Rocky Mountain Research Station, the USDA ARS European Biological Control Laboratory in Montpellier, France, Department of Entomology, Montana State University, and the Idaho Department of Agriculture, which is providing funding through its cost sharing program, coordinated by the Idaho Rush Skeletonweed Task Force.

The original Australian biocontrol effort concentrated on studying agents found bordering the Mediterranean Sea, an area that climatically matched the wheat producing areas of Australia where the weed was a major problem. The new program's objective is to search for new agents in areas with cooler climates, in particular cold, snow covered winters such as the higher altitude mountains of Greece and Turkey and in inland countries around the Black Sea, an area inaccessible to the Australian programs because of the Cold War. This report summarized the results of surveys and work conducted in 2003 in Eurasia and the progress in the release and introduction of the first of the new agents into North America.

References

McVean, D.N. 1966. Ecology of *Chondrilla juncea* L. in southeastern Australia. J. Ecol. 54: 345-365.

Sheley, R.L. and Hudak, J.M. 1995. Rush skeletonweed: a threat to Montana's agriculture. Montana State University Extension Service Bulletin. EB-132. 13 p.

Sheley, R.L. and Stivers, J. 1999. Rush skeletonweed. R.L. Sheley and J.K. Petroff (eds.). Biology and management of noxious rangeland weeds. Oregon State University Press, Corvallis, OR.

Whitson, T.D., editor. 1991. Rush skeletonweed *Chondrilla juncea* L. In: Weeds of the west. Jackson, WY: Western Society of Weed Science: 98-99.

Report of Research: G. P. Markin, USDA Forest Service, Rocky Mountain Research Station and J. Littlefield, MSU, Department of Entomology
Collaborators: Javid Kashefi (EBCL, Thessaloniki, Greece Field Station); Ivanka Lecheva (Bulgarian Institute of Higher Agriculture, Sofia, Bulgaria), Massimo Cristofaro (BBCA, Rome, Italy)
Research Assistance: Heather Prudy (Graduate Student, Entomology, Montana State University); Ani Stantcheva (Graduate Student, Bulgarian Institute of Higher Agriculture, Sofia, Bulgaria); Carlo Tronci (BBCA, Rome, Italy)

Clients: Idaho State Department of Agriculture; Montana State Department of Agriculture; U.S. Department of Interior; Bureau of Land Management, Snake River Basin District, Boise, ID; Boise National Forest; Sawtooth National Forest; Payette National Forest; Nez Perce National Forest; Panhandle National Forest; British Columbia Department of Forestry (Dwuane Brooks, Kamloops, BC)

Acknowledgements: For funding: Idaho Rush Skeletonweed Task Force for providing funds for this survey obtained through a cost share grant from the Idaho Department of Agriculture.

SEARCH AND STUDY OF POTENTIAL BIOLOGICAL CONTROL AGENTS IN BULGARIA

2003 was the third and final full year of a survey in Bulgaria, both to learn more about the distribution and climatic range of rush skeletonweed and its complex of natural enemies. In Bulgaria, the plant was found widely distributed from sea level at the Black Sea to approximately 1,500 m. It was most abundant in recently disturbed areas where it is a primary invader that can survive approximately 5 years before being replaced by other successional plants. Also several natural populations of skeletonweed have been discovered in undisturbed natural settings primarily open grasslands with sandy soil. Three permanent ecology plots have been set up and are being visited on a regular basis during the field season to chart the phenology of this plant and monitor changes in seasonal abundance of the different natural enemies.

Over 25 species of insects attacking rush skeletonweed have been collected in Bulgaria. The majority of these are probably polyphagus (capable of feeding on many different species of plants) or insects that have already been used as biocontrol agents, the gall midge, the gall mite, and the new root mining moth *Bradyrrhoa.* However, at least four new natural enemies that appear to be specific to skeletonweed have also been identified. Two of these have been receiving additional studies in order to learn more about their field biology and feeding behavior.

Photo: G. P. Markin-USFS

Figure 2. Small larvae of the moth *Schinia cognate* mining inside a bud of rush skeletonweed.

Schinia cognata (Lepidoptera: Noctuidae) Bud Feeding Moth

Newly hatched larvae feed inside buds, but as they grow older move from branch to branch feeding externally on the buds, and a single larvae can destroy 10 to 20 buds in its life cycle. Field observation indicates that we have two distinct populations of this insect a year and observations on adjacent, closely related Asteraceae plants has failed to find it on any plant other than rush skeletonweed.

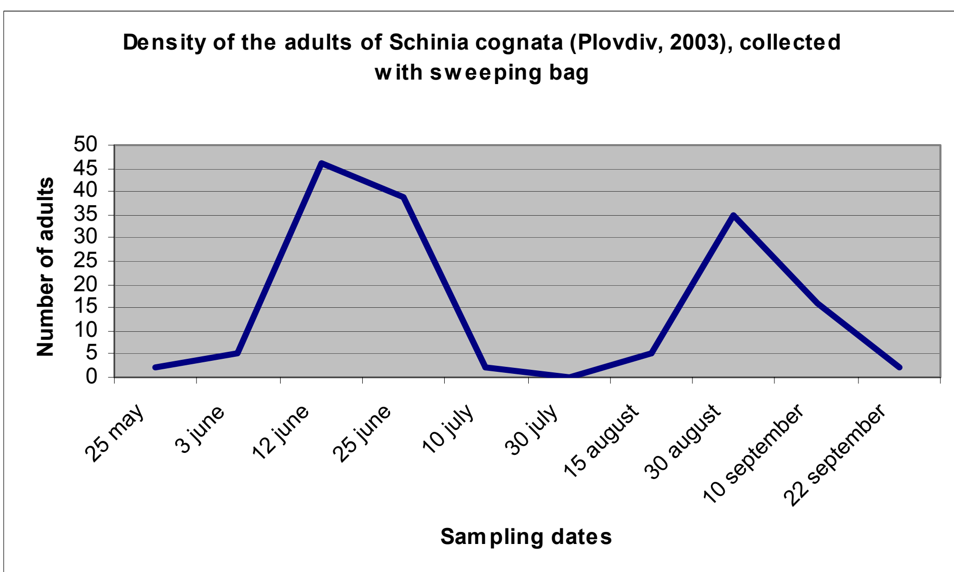


Figure 3. Seasonal abundance of adults of *Schinia cognate*, collected with sweep net, Plovdiv 2003. The two peaks indicate this insect has two generations a year.

Figure 4. Beetle larvae *Mordellistene* sp. Mining *Chondrilla juncea*. The larva has completed its development and is overwintering in the crown of the plant.

Photo: S. Resneck

Figure 5. Adults of a tumbling flower beetle *Mordellistena* sp. Reared from larvae in the roots of rush skeletonweed.

Photo: I. Lecheva

Mordellistena sp. (Coleoptera mordalidae) Root Mining Beetle

Larvae of this tumbling flower beetle mines in the core of the rush skeletonweed root descending as much as 6 inches before returning to the crown to overwinter and pupate in the spring. The insect has a wide distribution around the Black Sea, but seems to be particularly abundant in Bulgaria. The insect has one generation a year with the adults emerging in May or June and the larvae taking 3 to 4 months to complete their feeding before overwintering. Observations on the roots of adjacent plants in areas of high infestation have failed to find attack on other related composite plants leading us to believe that this insect may also be specific to rush skeletonweed.

Future Work.

Three years of survey has given us a fairly complete list of the natural enemies of rush skeletonweed in Bulgaria. At this point we are discontinuing efforts at survey and switching to detailed biological studies on the bud moth and root mining *Mordellistena* and particularly to initiate host testing (attempts to force the insects to feed on plants other than rush skeletonweed) to determine whether they are specific enough to be sent to quarantine in North America for more detailed studies. We also hope next year to expand our biological studies to several of the other Bulgarian insects, which may also have potential as biocontrol agents.

<u>Publications</u>

A summary of work conducted in Bulgaria was presented as an oral presentation at the September meeting of the Bulgarian Entomological Society. A publication “Search and Study of Potential Biological Control Agents in Bulgaria” by Ivanka Lecheva, Ani Stantcheva, and George P. Markin has been submitted and accepted for publication in “Journal ACTA Entomologica Bulgaria”.

SEARCH AND STUDY OF POTENTIAL BIOLOGICAL CONTROL AGENTS IN GREECE

Work on rush skeletonweed in Greece is the responsibility of Javid Kashefi, EBCL technician, stationed at their field lab in Thessaloniki. In 2003, much of his rush skeletonweed effort concentrated in supporting our work in the release of *Bradyrrhoa* in North America. In 2003, Kashefi made three shipments of *Bradyrrhoa* larvae to the Bozeman Quarantine, which provided the larvae for our release in Idaho (see section on *Bradyrrhoa* release). Lake Prespa in the northwest corner of Greece, is the main source of this insect, which we are releasing in Idaho. Kashefi is conducting monthly visits to this site to document the seasonal phenology of the plant and in particular, the seasonal biology of this *Bradyrrhoa* population, information that in the future will allow us to more accurately plan the release of this agent at new areas in North America.

Surveys for additional natural enemies of rush skeletonweed in Greece indicate that we have probably identified most of the complex found there. Only two new insects were found this year. A large weevil (Curculionidae) larvae was found attacking the crowns of skeletonweed at the higher elevations on the Island of Crete and in late fall, a stem mining beetle (probably a Cerambycidae) living in the pith of the dying plants was found along the coast of Greece. Normally, an insect attacking the pith of the dying stem would have no impact on the plant, but it was noticed that the mines often extend down into the living crown of the plant, which could open a pathway for invasion by pathogens or other natural enemies.

Photo: G. P. Markin-USFS

Figure 6. Larvae of an unknown Cerimbicea beetle, commonly found mining in the stem of dying *Chondrilla juncea* plants along the coast of northern Greece.

Future Work

Plans to work in Greece in 2004 will concentrate on continuing to support the release of *Bradyrrhoa* in North America, but will be expanded to include more detailed biological studies of several of the natural enemies we have identified in northern Greece, a sawfly, the complex of stem mining insects, and preliminary host tests to see if any are specific enough to be considered as potential biocontrol agents.

PRELIMINARY SURVEY OF NATURAL ENEMIES OF RUSH SKELETONWEED IN CENTRAL AND EASTERN TURKEY

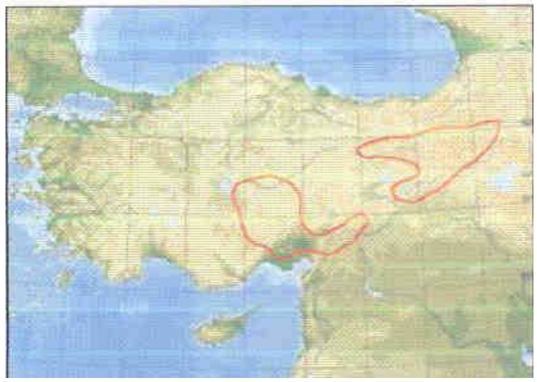


Photo: Carlo Tronci, BBCA

Figure 7. Explored areas 2003 in Turkey: on the left Cappadocia and southern Anatolia; right, eastern Anatolia.

While extensive surveys of skeletonweed have been conducted in the past in western Turkey, our program to date has not had good access to higher elevations of the Anatolia Plateau or mountains of eastern Turkey. On learning of our interest on rush skeletonweed, Massimo Cristafaro, director of BBCA Laboratories, Rome, Italy, directed his technician, Carlo Tronci, working in this area of Turkey to run a preliminary survey of the abundance and distribution of rush skeletonweed. Carlo reports that rush skeletonweed is widely distributed through this part of Turkey, although with a patchy distribution, from sea level up to 1,700 m. Again, it is most often found in disturbed areas, such as roadsides and ditch banks, and in abandoned farmland, but was occasionally found in permanent pastures. The insect natural enemies he reports finding are those we are already familiar with in Greece, Bulgaria, and the Republic of Georgia and we doubt that an extensive survey in this area will produce any new natural enemies. This area is of interest to us, however, because it is probably part of the range of the root boring beetle, *Sphenoptera claresens* (Coleoptera: Buprestidae). In 2002, Javid Kashefi found this insect in central Turkey (see 2002 Rush Skeletonweed Report) and we know from the literature that it also occurs to the east in Iran so we suspect that this part of Turkey may give us access to a large population of this beetle if we should decide to study it in more detail in the future. Carlo also reports that there are several universities with departments of entomology containing qualified scientists, who could work with us as collaborators in this area if we should want to undertake studies of this beetle.

Figure 8. Larvae of *Sphenoptera claresens* in a rosette crown of rush skeletonweed from central Turkey.

Photo: G. P. Markin-USFS

STUDY OF POTENTIAL BIOLOGICAL AGENTS IN RUSSIA

Figure 9. Key cooperators of the Biocontrol Group of the Russian Zoological Institute, St. Petersburg, foreground, Sirgay Resneck, middle, Mark Volkovitch, and rear, Margarita Dolgorskaya.

Photo: G. P. Markin, USFS

After several years of effort, we have finally managed to establish contact with entomologists at the Biological Control Group of the Zoological Institute of the Russian Academy of Science in St. Petersburg. Here, three entomologists, Margarita Dolgorskaya, Mark Volkovitch, and Sirgay Resneck, have been working in cooperation with Massimo Cristafaro of the BBCA Laboratory of Rome to perform surveys and host testing of potential biocontrol agents for several other Eurasian weeds under contract with EBCL. During the 2003 field season, these entomologists, while working in southern Russia opportunistically surveyed for and examined rush skeletonweed in three separate areas:

Figure 10. Regions where material was collected in Russia (1) Stavropol territory, (2) Astrakhan province, (3) Krasnodar territory.

Krasnodar Territory: This is the portion of Russia that borders the north shore of the Black Sea. Inland, rush skeletonweed was rare, but plants were sometimes abundantly growing at several areas just above Black Sea beaches. Plants were generally scattered and no dense, extensive stands of rush skeletonweed were found. Insect populations (visited September 5th) were sparse.

Photo: Mark Volkovitch.

Figure 11. Typical steppe vegetation in Stavropol territory in which *Chondrilla juncea* was found growing.

Stavrolpol Territory: This area, which lays between the Black Sea and Caspian Sea, on the north side of the Caucasas Mountains, is open, grassy steppe in which rush skeletonweed was located at four sites in late June and through July. Plants still had basal rosettes, although most had bolted and were beginning to produce flowers. In general, plant populations were low with no noticeable concentrations or extensive stands. Most plants were located in relatively undisturbed natural grasslands. Insect populations were again low.

Photo: Mark Volkovitch

Figure 12. *Chondrilla juncea* found growing in typical desert shrub vegetation in southern Astrakhan province of southern Russia.

Photo: Mark Volkovitch

Figure 13. *Chondrilla juncea* growing in vegetated sand dunes along the Volga River, Astrakhan province, southern Russia.

Astrakhan Province: The Astrakhan Province lays at the north end of the Caspian Sea and extends north up the Volga River. The area is of particular interest to us since it marks the borderline between the steppe and prairies of eastern Europe and the western edge of the deserts of central Asia and while the area is low (elevation approximately sea level) it is the most interior site in Eurasia that we have so far been able to locate rush skeletonweed. Rush skeletonweed could be found at almost all locations surveyed, although along the west side of the Volga River in a desert environment fairly extensive stands of skeletonweed were located and examined. *Bradyrrhoa gilveollela* was relatively abundant here and represents the eastern most and northern most population of this insect we have found and may be very valuable to us in the future as we need to locate populations in new climatic zones that will be suitable for future releases in new areas in North America. Two new foliage feeding moths *Cucullia balsamitae* (Lepidoptera: Noctuidae) and an Arctiidae moth, both new to our list of natural enemies of rush skeletonweed were found here. Another insect, a second root boring beetle *Sphenoptera foveolal* (Coleoptera: Buprestidae), is reported from the Russian literature to exist in this area, but was not found in this survey, although they were not specifically looking for it.

Photo: Mark Volkovitch

Figure 14. Larvae of *Cucullia balsamitae* Boisd. (Lepidoptera: Noctuidae) feeding on *Chondrilla juncea*, Astrakhan province, southern Russia.

Photo: Mark Volkovitch

Figure 15. Larva of wooly bear (Lepidoptera: Arctiidae) feeding on *Chondrilla juncea*, Astrakhan province, southern Russia.

Of the three areas in Russia, the Krasnodar and Stavrolpol areas appear to be fairly similar to habitats we have already surveyed around other parts of the Black Sea. The Astrakhan area, however, is of particular interest to us. We are finally leaving lower elevation habitats that we have extensively surveyed to date and are beginning to approach the central Asian deserts. While at sea level the area is notorious for a cold, hard winter, and still lies within Russia proper, which would be easy to access by plane from St. Petersburg. During a visit in November to the Russian Academy of Science in St. Petersburg, we discussed the cost and feasibility of conducting surveys, both here in the Astrakhan area and possibly moving further east into the central Asian republics. Working with the Russian Academy of Science with their contacts and experience in this area, it appears we now have access to a major new part of the range of the genus of *Chondrilla* (see below).

Stem and Root Mining Beetle

Figure 16. Several hundred specimen of the beetle *Sphenoptera flavoli* in the insect collection of the Natural History Museum at St. Petersburg, Russia.

Photo: G. P. Markin-USFS

One of the insects that has been reported repeatedly in the Russian literature as attacking rush skeletonweed or at least other closely related species of *Chondrilla*, is a second root mining beetle, *Sphenoptera flavolia* (Coleoptera:

Buprestidae). While in St. Petersburg, a survey was made of the insect collection of the Russian Academy of Science's Museum of Natural History, where we were able to examine a collection of several hundred specimen of this insect. *S. flavolia* appears to have high potential as a biocontrol agent for several reasons. It is very large and would cause extensive damage, particularly in the crown of the plant. Host records on these specimen also indicate that it had been collected only on various species of *Chondrilla* indicating it may be restricted to this plant. However, the records also indicated that its range lies to the east of the Volga River primarily in the central Asian republics of Kazakhstan and Uzbekistan. We discussed the possibility of an expedition to this area to learn more of the biology of this insect and collect specimen to begin a colony with in St. Petersburg at the Institute of Zoology's Biocontrol Laboratory. From examining the host record of this insect and the distribution records of *Chondrilla* herbarium specimens from this area we selected the most likely area to investigate would be eastern Kazakhstan around the city of Almada and north around Lake Balkhash. This area would give us access to dry mountains known to contain *Chondrilla* populations, low sandy deserts, and the southern edge of the Asian steppe. If funding is available, we will try to organize an expedition to this area in 2004.

Species and Distribution of the Genus *Chondrilla*

Photo: G. P. Markin-USFS

Figure 17. Three of the nine cabinets containing pressed specimen of *Chondrilla* in the Russian Komaror Botanical Institute Herbarium, St. Petersburg, Russia.

Figure 18. Examining species of the various species of *Chondrilla* in the Russian Komaror Botanical Institute Herbarium, St. Petersburg, Russia.

Photo: G. P. Markin-USFS

A visit to St. Petersburg in November 2003 provided a unique opportunity to learn more about the genus *Chondrilla* and its worldwide distribution. Visits to other herbariums such as Kew Gardens in London, have generally been unproductive since they contain few specimen of the genus *Chondrilla*, mostly *Chondrilla juncea* collected in southern Europe. Visit to the Komavor Botanical Institute Herbarium in St. Petersburg allowed access to what is probably the largest collection of specimen of *Chondrilla* in the world. Some of the preliminary information obtained were (1) the range of *Chondrilla juncea* extends from Volga River westward through Europe to the Atlantic Ocean and south around the Mediterranean. Eastward, *Chondrilla juncea* appears to be replaced by the very closely related species *Chondrilla brevilostzis*, which extends eastward through Asia to at least the Chinese border. (2) Worldwide, there are 22 species of the genus *Chondrilla*. The taxonomy of the group was most recently worked on in 1960 by T. G. Leonava and published in 1963 in the "Flora of the USSR". Botanists at the Herbarium consider this work to be still valid and that there are no reasons to question the species identified by Leonava. (3) The obvious center of origin and epicenter of distribution of the genus *Chondrilla* is in central Asia in the dry steppe and shrub desert zone between the Caspian Sea and the Himalayan Mountains and south of the edge of the boreal pine forests of Russia. (4) The preferred habitat of most species of *Chondrilla* appears to be sandy, open soil, upward as high as 3,000 m on dry mountains surrounding this desert. The central desert area contains 19 of the 22 identified species of *Chondrilla*. Five of these species extend westward into Europe, but only *Chondrilla juncea* extends west beyond the Balkan Pennisula into southern Europe.

Future Work

The concentration of species of *Chondrilla* in this central desert area (very similarly climatically and latitudinally to the deserts of western United States) may indicate that this is the area and habitat that this plant evolved. It is expected, therefore, that this may be the best place to look for natural enemies of *Chondrilla,* which have coevolved with this plant. Even though *C. juncea* is not found in this area, it is expected that any insects that have coevolved with the genus in general, would probably also attack rush skeletonweed. This we feel supports our need to try to expand the survey of skeletonweed natural enemies into this untouched and unexplored zone of Asia.

2. 2003 Rush Skeletonweed Biological Control - Project Summary for *Bradyrrhoa gilveolella*

J. Littlefield – Montana State University, Bozeman, MT
H. Prody – Montana State University, Bozeman, MT
G. Markin – US Forest Service, Bozeman, MT
J. Kashefi – USDA-ARS-EBCL, Thessaloniki, Greece

<u>Introduction</u>

Bradyrrhoa gilveolella (Treitschke) (Lepidoptera: Pyralidae) is a root-feeding moth being considered for use in the biological control of rush skeletonweed, *Chondrilla juncea* L. (Asteraceae). This organism will serve to complement the existing biocontrol agents that have been established on rush skeletonweed in the Pacific Northwest but have provided only limited suppression of the weed. In autumn 2002 the USDA-APHIS approved this moth for field release. In November 2002 the first release of the moth (as infested plants) was made near Garden Valley, Idaho. Key to the success of this agent is our ability to effectively establish and redistribute the moth. For the 2003 field season we continued with the release of the moth and initiated a study to determine habitat associations of the moth in Europe so that we may seek similar sites in North America for future releases.

Objective 1. Release & redistribution of the root moth *Bradyrrhoa gilveolella*.

Two collections of rush skeletonweed roots infested with *Bradyrrhoa* larvae were made near Lake Prespa in northwestern Greece. Roots were sent or hand carried to the Insect Quarantine Laboratory located at Montana State University. Approximately 57 adult moths were reared from the first collection from northern Greece. From these adults we obtained a little less than 3,400 eggs. Egg viability was estimated at 82%. The resulting larvae were used for field release, establishing a laboratory colony and for diet and feeding studies. Viable eggs were also sent to the Nez Perce Biocontrol Center to start a field insectary. The second shipment of roots was received in September 2003 and the larvae from this shipment were transferred to plants for additional rearing in the quarantine lab.

Releases were made in August 2003 at four sites in southern Idaho: Goodrich, Banks, Garden Valley, and Idaho City. Approximately 1,020 larvae were placed on plants at these field locations. Sites were revisited on 20 September 2003 and ten plants were inspected for the establishment of larvae. Larvae were located at two sites. Hot temperatures during the release of the larvae may have contributed to the poor establishment at the other two sites. These sites will be revisited in 2004. An additional release of *Bradyrrhoa*, using eggs obtained from laboratory rearing, was made in October 2003 near the Salmon River.

A few infested plants were placed near Garden Valley, ID in November 2002. Plants were removed in September 2003 and dissected. Although few in number, nearly all the larvae pupated and emerged as adults. This indicates the likelihood that *Bradyrrhoa* will be able to survive the Idaho winters.

A laboratory colony is being maintained at MSU and at the USFS Forestry Science Laboratory, Bozeman. We hope to continue the colony so that additional moths may be released in 2004. To augment the rearing of the moth, work on the development an artificial diet began. On preliminary diets, larvae fed for extended periods and more mature larvae completed their development to emerged as adults. Studies were also initiated to investigate the impacts of larval feeding on the root.

Objective 2. Determine habitat associations of *Bradyrrhoa gilveolella* in Europe.

A total of nine sites were surveyed in Greece, six in Bulgaria, and eight in Idaho. Aspect, slope, elevation, average *C. juncea* plants per area, presence of *B. gilveolella*, and other site parameters were recorded for each site visited. A total of three surveyed sites in Europe contained *B. gilveolella.* Soil samples were also taken at each site. Data analysis for the European and Idaho sites will be conducted this winter.